The Valley Group, Inc.

CAT-1™ Transmission Line Monitoring Systems

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IEPR Committee of
California Energy Commission
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Comments on: California's Electricity Generation and Transmission Interconnection Needs under Alternative Scenarios, Workshop on April 5, 2004.

The consultant's report presents a clear selection of alternative demand and generation need scenarios and focuses on needs on transmission interfaces for import into California. We are in complete agreement with the report regarding the need to develop such interfaces. We also agree on the need to start active pursuit of such plans at an early date, because of the significant complexities of such interstate agreements. A reasonable certainty of added interface capacity could also encourage generation development in neighboring states and in Mexico.

Nevertheless, we feel that this study should also be extended to several important considerations related to California's internal transmission network, which are outlined below.

1. Internal transmission constraints caused by load growth

With the projected peak load growth from the present 52 GW to 80 GW in 2030, the internal power transfers within California will become extremely constrained, even if all present generating facility locations were maintained (i.e. retired power plants were replaced with equal or greater capacity plants at the same locations) The present situation can be investigated using "Normalized Transmission Capacity" as defined by Hirst [1] based on the initial concept of Seppa [2].

Normalized transmission capacity is defined by adding the total transfer capacity (in Gigawatt-miles) of all lines in the network and dividing this sum by the peak load (in GW). In essence, it represents the maximum distance to which an average generating plant can sell power under peak load conditions in a non-contingent network. Table I below shows the current California situation.

Table I. Normalized Transmission Capability of California in 2003

Voltage, kV	60-100	100-161	230	500	DC	Total
Circuit miles	13000	8500	10500	3000	600	**35600**
Capability GW	0.05	0.12	0.40	1.50	3.00	
GW-miles	650	1020	4200	4500	1800	**12170**
Peak load, GW						**52**
Normalized network capability, miles						**234**

The table shows that the 35,600 miles of transmission and subtransmission network in California has a total transfer capability of about 12,000 GW-miles. 70% of this capability (8,700 GW-miles) is in the 230 kV and 500 kV systems. The table also shows that the reasonable radius at which an average generator can expect to sell energy is now 234 miles.

If the expected 60% growth occurs and the network topology remains constant (locations of loads and generation remain the same), maintaining the present level of congestion requires construction of at least 8000 miles of 230 and 500 kV circuits, or an equivalent amount of system upgrades. In addition, the 60-160 kV HV transmission network requires substantial strengthening. Even without considering replacement of aging lines, this endeavor is going to be very expensive and politically divisive.
If transmission system in California is not reinforced at all before 2030 and the load growth is the predicted 60%, the trade radius of an average generator will reduce from 234 miles to 146 miles. This means that the trade area of such a generator will reduce to 40% of its present value, because trade area is proportional to the square of the radius. In such a market generators would become de facto local monopolies.

2. Impact of import of energy

California is 800 miles long and 250 miles wide. If power is imported from the state borders, it has to be moved to the consumption centers, most of which are far from the planned import sources. Unless the internal transmission network is strengthened substantially, benefits of potentially less expensive imported energy will become localized near the border regions of the import sources. The results will be a wide variation of constraint costs and localized electricity prices in the system. This will require a significant strengthening of California's internal 500 kV network, or adoption of even higher voltages (765 kV or +/- 500 kV DC). This has significant economic and political costs.

3. Impact of renewable resources.

Renewable resources present special challenges for transmission networks.

Renewable generation must generally be located at sites where those resources are available. As a rule, it means that the economically best locations are at sites where the transmission network is weak or does not exist. As long as the percentage of renewable energy is low, the network problems are manageable. It is generally felt that when renewables exceed 10-15% of the generation mix, the challenges become progressively more difficult.

For example, wind power is very commonly connected to subtransmission or primary distribution system. Such connections cause not only potential line overloads; they can also cause substantial voltage problems in the HV and EHV transmission network. The existing networks are generally designed with a voltage drop from EHV towards distribution and subtransmission. When a substantial amount of generation is connected to subtransmission, this voltage profile reverses, and can limit power transfers at the EHV level. Such problems are evident in e.g. Denmark and Northern Germany, where long distance international contracts are sometimes very limited during periods of high wind generation.

The second problem of renewables is their generally low capacity factor, the variation of which has a large random component. To fully utilize renewable generation requires a larger transmission investment than what is needed for a generator which can be scheduled based on demand.

It is quite likely that the increase of the renewable part in the generation portfolio will require substantial adjustments to the transmission system of California.

Conclusions

The selected generation policy options may have multiple and substantial impacts in the need for transmission network construction inside California, as well as the studied import interfaces. Such impacts and the methods to mitigate them should be carefully considered before the final recommendations are made regarding resource policies.

Sincerely,

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President
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References:

1. Eric Hirst and Brendan Kirby: "Transmission Planning for a Restructuring U.S. Electric Industry." Edison Electric Institute, June 2001.

2. Tapani Seppa: "Improving Asset Utilization of Transmission Lines by Real Time Rating." IEEE T&D Committee Meeting at IEEE/PES Summer Power Meeting, Edmonton, Alberta, Canada, July 22, 1999.